APPLICATION FOR PATENT

Title: Cartridge Retrievable Flow Control Valve

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FIELD OF THE INVENTION

[0001] The field of this invention relates to flow control valves where the internals can selectively be removed or inserted separately or as unit through a cover bonnet.

BACKGROUND OF THE INVENTION

[0002] Flow control valves come in a variety of designs. One common design involves relative movement between a stationary orifice and a movable orifice which results in variation of the pressure drop across the valve body with the resulting required flow or pressure or some other type of control. The valve body can take all the pressure drop resulting from such relative movement in one or more stages, with each stage of pressure drop created by a discrete pair of stationary and movable orifice. Illustrative of a relevant design to the present invention is U.S. Patent 5,365,978 showing a top entry valve with two sets of orifices. There is a pair of discs in the body closest to the outlet representing the second stage of pressure reduction in the valve body. The stationary disc 16 is held to the body wear insert 14A in Figure 8 and the wear insert itself is held to body 12A by pins 154 that extend into machined holes in the body 12. The stem assembly 72 has a pair of opposed tabs 166 at its lower end that can be placed under tabs 200 of the wear sleeve 14A as shown in Figure 15. Alternatively the stem assembly 72 can have a thread 246 shown in Figure 18 that, when desired, can be moved to engage a mating thread 248 on wear sleeve 14B, as shown in Figure 19. A pin or pins 70 extend from the lower end of the stem assembly 72 to engage the movable disc18 for selective alignment or misalignment of orifices 54 with stationary orifices 44. A related reference to this patent is U.S. Patent 5,217,046. One of the objectives of the prior designs was to allow the stationary disc16 to be removed together with the stem assembly. U.S. Patent

5,365,978 offered two ways to do this. In essence the wear sleeve had to be selectively engaged by stem assembly so that with the bonnet removed, the stationary disc and the wear sleeve would come out together. In both proposed solutions the stem assembly needed to be manipulated to catch the wear sleeve. One way was with a selectively engaging thread and the other was a bayonet style where opposed tabs had to be driven past another set of opposed tabs on the wear sleeve, then turned 90 degrees to make the tabs align so that an upward pull on the stem assembly would bring out with it the wear sleeve and the stationary disc within the wear sleeve.

[0003] The problems with these solutions require a more precise machining of all the components to limit the axial travel of the valve internals in both the pressurized and non-pressurized conditions. At pressurized conditions, which would create a separating force on the internals, if the tolerance of the internals is not tight enough, it is possible for the tabs to incorrectly be located on the same plane. Under these binding conditions, it is possible to be unable to control the opening of the valve, possibly resulting in the damage of the stem or actuator.

[0004] The threaded configuration design, Figure 27 of U.S. Patent 5,365,978, would inherently create a thread pitch in travel from the wear sleeve relative to the stem per rotation of the stem. The wear sleeve could dislodge from securing pins, Items 154 of Figure 20 of U.S. Patent 5,365,978, from excessive travel, thus giving rise to an uncontrollable valve.

[0005] There were other problems inherent to the design of the prior art described above. The need to place with precision the bores in the body to accept pins 154 shown in U.S. Patent 5,365,978 added considerably to the manufacturing cost of the valve shown. In addition to the considerable manufacturing cost, is the alignment difficulty of properly installing the sleeve into the valve body. Additionally the movable disc 18 was driven by a pair of pins 70 that extended from the lower end of the stem assembly 72. The movable disc is prone to vibrate back and forth at high frequency, also known as chatter, during certain flow conditions and disc positioning. The chatter would cause a potential for undue wear on the minimal connecting pair of pins 70. The failure of these pins would

result in the inability to drive the disc 18, thus creating an uncontrollable valve, which would require a system shutdown or a system bypassing of the valve so that it could be disassembled and repaired.

[0006] The present invention allows the cage that supports the fixed disc to be supported against rotation and for insertion or removal from the bonnet. It eliminates the need for precision machining of small bores in the body. The movable disc is operated by a drive fork as part of the stem assembly to increase reliability of that connection and further reduce manufacturing cost. The increased area of engagement between the controllable disc and the fork will prolong the life in an environment prone to chatter. The fixed disc is preferably secured to the cage using a Woodruff type key. The entire assembly is now simply installed or removed from the body and the problems of stem chatter and uncertainties of capturing the assembly holding the fixed disc are reduced. These and other advantages of the preferred embodiment of the invention will be more readily apparent to those skilled in the art from the description of the preferred embodiment, which appears below and from the appended claims that indicate the broad range of the invention.

SUMMARY OF THE INVENTION

[0007] A flow control valve has a fixed orifice adjacent to a movable orifice. The fixed orifice is secured to a cage that is in turn secured to a bonnet. This allows the fixed and movable disc to be simply installed and removed from the body through the bonnet. The stem assembly features a forked member for a strong grip of the movable disc. The design removes the need for precision machining bores in the body and facilitates assembly or removal of the valve internals.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 is a section view through a valve showing the arrangement of the components;

[0009] Figure 2 is an exploded view of the valve internals in Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] Referring to Figure 1, the valve **10** has a body **12** with an inlet **14** and an outlet **16**. A bonnet **18** closes off the top entrance **20** with a series of bolts (not shown) guided by pin **22** for initial alignment and a seal **24**. A stem assembly **26** comprises a shaft **28** that extends through bonnet **18** with a seal **30** surrounding it. An operator such as a hand wheel or valve actuator (not shown) can be secured to the shaft **28** outside of bonnet **18** to operate the valve **10**. One or more flats **32** can be located at the end of shaft **28** to facilitate attachment of a hand wheel or actuator, as shown in Figure 2.

[0011] A pair of longitudinally extending members **34** and **36**, preferably located 180° apart extend from a hub **38** connected to the lower end of shaft **28**. Movable orifice disc **40** has a pair of cutouts, one of which **42** can be seen in Figure 2. The extending members **34** and **36** go into the cutouts **42** so that rotation of the shaft **28** results in rotation of the movable disc **40** and the one or more orifices **44** that extend through it.

[0012] A cage **46** has an upper end **48** and a lower end **50**. A cage insert **52** is secured near lower end **50**. An exterior groove **54** holds a seal **56** to seal against the body **12**. The upper end **48** featured slots **58** into which pins **60**, that are mounted to bonnet **18**, extend. Pins **60** are secured in bores **62** in bonnet **18**. Cage **46** has an opening **64** that aligns with inlet **14** to allow inlet flow through cage **46** to reach orifices **44** in movable disc **40**.

[0013] One or more slots **66** are located through the wall of cage **46** to allow on or more Woodruff keys **68** to extend into or adjacent stationary disc **70** that has one or more orifices **72**. Additionally, cage **46** has openings **74** to accept screws **76** to extend into bonnet **18**.

[0014] A thrust bearing **78** reduces the torsional load to operate stem **28** and braces the hub **38** with the bonnet **18**.This bonnet **18** is secured to body **12** with bolts (not shown) using guide **22** for initial alignment. Longitudinal motion is prevented upon assembly to minimize chatter of the shaft **28**.

[0015]

[0016] Those skilled in the art can now readily appreciate some of the advantages of the illustrated preferred embodiment of the invention. The cage **46** secures the stationary disc **70** in the body **12** without having to precision machine bores in the body to locate pins to hold the stationary disc in position as in the past in U.S. Patent 5,365,978. Instead pins **60** prevent rotation of the cage **46** and those pins extend from the bonnet. Additionally the fixed disc **70** is secured to the cage **46** through openings **66** in the cage. Again the placement of the fixed disc **70** requires no precise machining on body **12**, as in the past. The fixed disc **70** can be secured to the cage **46** in a manner that permits replacement when the valve **10** is disassembled. Unlike the prior designs there is no built in axial play required in the present invention as screws **76** provide a releasable connection to the bonnet **18** directly. The uncertainty of bayonet style or threaded component engagement required for retrieval of the fixed disc in the prior design is eliminated. The risk of chatter failure is greatly reduced. The expensive electrical discharge machining process on the body **12** of valve **10** is no longer required. The movable disc **40** is driven by the robust extending members **34** and **36** instead of the more flimsy pins, as in the prior design. As a result, the present invention allows the valve **10** to be manufactured more cheaply and facilitates assembly and disassembly. While a single stage pressure reduction is illustrated in the preferred embodiment, those skilled in the art will appreciate that a multistage configuration can be easily adapted to have the desirable features of the present invention. For example, the body **12** can include another fixed orifice adjacent inlet **14** and the opening **64** in cage **46** can feature a mating orifice that can be brought into and out of alignment with the fixed orifice in body **12** as the shaft **28** is rotated.

[0017] While a Woodruff key or keys are illustrated, the fixed disc **70** can be held to cage **46** in a variety of equivalent ways such as by pins or snap rings or other types of fasteners, without departing from the scope of the invention.

[0018] The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made without departing from the scope of the invention.